Antibiotic resistance patterns of urinary tract infections in Sanandaj, Iran

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A R T I C L E   I N F O

A B S T R A C T

Introduction: Urinary tract infection is one of the most common infections. About 10% of people experience it in their lifetime. Due to the significant increase in antibiotic resistance and the unpredictability of antibiotic susceptibility of pathogens, the availability of antibiotic susceptibility testing results can be useful in the selection of the antibiotics based on the type and pattern of antibiotic resistance of the pathogen.
Objectives: The aim of this study was to determine the antibiotic resistance pattern of bacteria producing urinary tract infection in Sanandaj, Iran.
Materials and Methods: This cross-sectional study was performed on 3126 urinary samples from Tohid hospital in Sanandaj University of medical sciences in 2017. The urine specimens were cultured on EBM (Eosin Methylene Blue) and blood agar media. Kirby-Bauer's standard disk diffusion method was applied to test the susceptibility of the drug for Mueller-Hinton culture agar plates. The results were extracted based on the criteria of CLSL (Clinical and Laboratory Standards Institute).
Results: In the study of the samples, the results of 708 cultures (22.64%) were positive. Among the urinary pathogens, *Escherichia coli* with 291 cases (41/10%) was the most common isolated bacteria. According to the results of antibiogram, the highest antibiotic resistance was observed for cefixime (92.51%), ceftriaxone (52.54%) and cotrimoxazole (45.48%). The highest antibiotic sensitivity was observed for imipenem (96.11%), nitrofurantoin (91.67%) and ceftazidime (88.28%).
Conclusion: According to this study, the highest antibiotic resistance was observed with cefixime, ceftriaxone and cotrimoxazole that these drugs are not recommended as the first line of antibiotic therapy. On the other hand, the highest antibiotic susceptibility was observed with Imipenem, nitrofurantoin and ceftazidime, which should be considered in the treatment of urinary tract infections.

Introduction

Urinary tract infection is one of the most common infections. About 10% of people experience it in their lifetime (1). Its prevalence varies with many factors, the most common of which is the low socioeconomic level. Indigent patients have five folds risk. The most common pathogen, Escherichia coli, is from Enterobacteriaceae family with a prevalence of 75%-90%. Other common pathogens are *Klebsiella pneumoniae, Proteus mirabilis* and *Staphylococcus saprophyticus* (2,3).

Due to the complications of urinary tract infections, a proper and timely antibiotic treatment is important. However, in most cases, an empirical treatment is performed, but given the significant increase in antibiotic resistance and the unpredictability of pathogens' antibiotic susceptibility, the availability of antibiotic susceptibility testing results can be useful in the selection of the antibiotics based on the type and pattern of antibiotic resistance of pathogen (4,5).

Therefore, determining the antibiotic resistance pattern

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in common pathogens in urinary tract infection is important for empirical and specific treatment against a pathogen.

Objectives

Since antibiotic therapy in urinary tract infections must be based on epidemiology and the pattern of resistance in the field of uropathology, this study was conducted to determine the antibiotic resistance pattern of bacteria producing urinary tract infections in Sanandaj to propose logical strategies for the treatment of urinary tract infections in this area.

Materials and Methods
Study design

This cross-sectional study was performed on 3126 urinary sample from the central laboratory of Tohid hospital in Sanandaj from October 2016 to September 2017. In this study, urine specimens were collected in sterile containers from the midstream urine sample and were cultured in sterile conditions on EBM (Eosin Methylene Blue) and blood agar, by using a calibrated loop (0.01 mL) and then, the samples were examined at 37°C for 18-24 hours incubation. The samples that the number of colonies grown on their culture medium was more than 10^5 CFU/mL were examined as a positive urine culture to identify genus and bacterial species based on standard methods.

After the final diagnosis, the Kirby-Bauer's standard disk diffusion method was used to test the susceptibility of the drug on Mueller- Hinton agar plates. Creation or absence of the size of inhibition zone around the disk was reviewed based on the criteria of the clinical and laboratory standards institute (CLSI) (6). The most commonly used antibiotic in urinary tract infections was reviewed in the studied antibiogram.

Ethical issues

The study was conducted in accordance with Tenets of the Declaration of Helsinki. In this research, we followed all the ethical considerations related to research on patients' clinical samples. The study was approved by the Research Committee and the Ethical Committee of Kurdistan University of Medical Sciences. (Ethic code; IR.MUK. REC.1397.5014).

Data analysis

SPSS software was used for descriptive analysis and chi-square test. P value < 0.05 was considered as a significant level.

Results

Among 3126 studied patients, 1822 patients (58.28%) were female and 1304 patients (41.72%) were male. The age of the patients varied from 18 years old to 89 years old. In the reviewing of the samples, the results of the cultures of 708 samples were positive (502 female and 206 male). Among urine pathogens, *E. coli* with 291 cases (41.10%) was the most common isolated bacteria (Figure 1).

According to the results of antibiogram, the highest antibiotic resistance in both genders, regardless of the type of bacteria was observed with cefixime (92.51%), ceftriaxone (52.54%) and cotrimoxazole (45.48%). The highest antibiotic susceptibility was observed with imipenem (96.11%), nitrofurantoin (91.67%) and ceftazidime (88.28%).

Escherichia coli as the most common cause of urinary tract infections has been shown the highest resistance to cefixime (93.81%), ceftriaxone (60.13%) and cefotaxime (51.89%) and the highest susceptibility to meropenem (95.54%), nitrofurantoin (95.19%) and imipenem (93.82%) (Table 1).

In this study, 163 bacteria (23.02%) produced extended-spectrum beta-lactamases enzymes (ESBL). *E. coli* with 108 cases (63.25%) was the most common bacterium producing ESBL (Table 2).
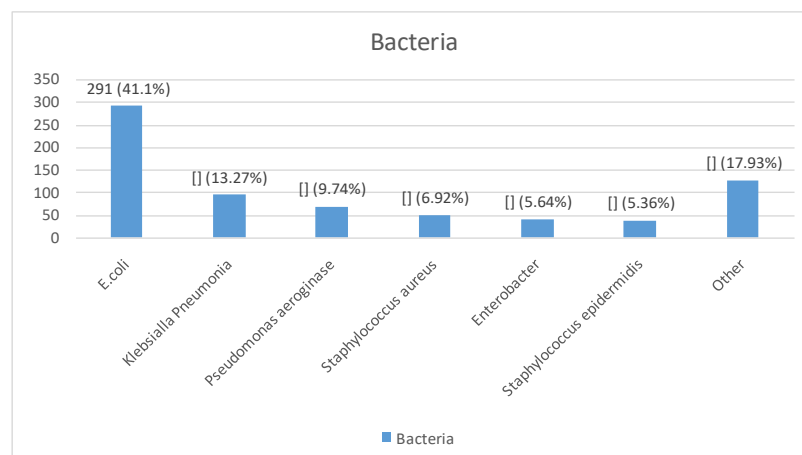

Figure 1. The frequency of urinary tract pathogenic bacteria isolated from positive urine culture specimens.

Table 1. Antimicrobial resistance pattern of bacterial pathogens isolated from positive culture

Antibiotic	Organisms, No. (%)					
	E. coli	*Klebsiella*	*Pseudomonas*	*Staphylococcus aureus*	Other	Total
Cefixime	273 (93.81)	84 (89.36)	59 (85.50)	44 (88)	195 (95.58)	655 (92.51)
Ceftriaxone	175 (60.13)	41 (43.61)	63 (91.30)	40 (80)	53 (25.98)	372 (52.54)
Cotrimoxazole	143 (49.14)	33 (35.10)	35 (50.72)	22 (44)	89 (43.62)	322 (45.48)
Ciprofloxacin	112 (38.48)	39 (41.48)	53 (76.81)	24 (48)	93 (45.58)	321 (45.33)
Cefotaxime	151 (51.89)	53 (56.38)	34 (49.27)	0 (4)	35 (17.15)	273 (38.55)
Cefepime	102 (35.05)	51 (54.25)	41 (59.42)	0	40 (19.60)	234 (33.05)
Ampicillin	90 (30.92)	37 (39.36)	28 (40.57)	2 (4)	55 (26.96)	212 (29.94)
Gentamicin	57 (19.58)	24 (25.53)	32 (46.37)	12 (24)	50 (24.50)	175 (24.72)
Meropenem	13 (4.46)	20 (21.27)	43 (62.31)	0	34 (16.66)	110 (15.53)
Ceftazidime	31 (10.65)	10 (10.63)	28 (40.57)	0	14 (6.86)	83 (11.72)
Nitrofurantoin	14 (4.81)	13 (13.82)	14 (20.28)	2 (4)	16 (7.84)	59 (8.33)
Imipenem	18 (6.18)	4 (4.25)	2 (2.89)	0	0	24 (3.89)

Table 2. The prevalence of ESBL bacteria isolated from positive urine culture specimens

ESBL	Organism
108 (66.26)	*E. coli*
41 (25.15)	*Klebsiella pneumoniae*
6 (3.68)	*Pseudomonas aeruginosa*
6 (3.68)	*Acinetobacter*
2 (1.23)	*Enterobacter*
163 (100)	Total

Discussion

This study showed that urinary tract infection was more prevalent in females than males, which is probably due to the shortness of urethra and the proximity of its outlet to vagina and the anus in women (7). In this study, *E. coli* with 41.10%, *K. pneumoniae* with 13.27% and *P. aeruginosa* with 9.74% were the most common pathogens responsible for urinary infections. Other studies also indicate that *E. coli* is the most common pathogen in urinary tract infections. The prevalence of *E. coli* was reported in the study of Cheema and colleagues in Pakistan as 73.22% (3) and in the study of Cordoba et al in Denmark, it was 70%, while, Cunha et al detected, *E. coli* in 60.4% of urinary tract infections.

In this study, in both genders, the highest resistance was observed with cefixime (92.51%), ceftriaxone (52.54%) and cotrimoxazole (44.48%) (Regardless of the type of bacteria). The highest susceptibility was observed with imipenem (96.11%), nitrofurantoin (91.67%) and ceftazidime (88.28%).

Ren et al (9), reported the highest resistance to ampicillin (86.9%), ciprofloxacin (80.3%), aztreonam (61.7%) and the highest susceptibility to ertapenem (100%), imipenem and piperacillin (100%) and tazobactam (86.1%). Nzalie et al reported the highest resistance to ampicillin (69.17), cotrimoxazole (63.6%) and amoxicillin/clavulanate (60%) (10). They reported the highest susceptibility to gentamicin (98.2%), levofloxacin (94.5%) and ceftriaxone (94.5%). Rajabnia et al (11) reported the highest resistance to cefixime (84.5%), sulfamethoxazole (66.14%) and the highest susceptibility to ciprofloxacin (83.63%) and nitrofurantoin (80.78%).

The results of this study and others show that the pattern of antibiotic resistance varies in different geographical locations and races. This distinction indicates the necessity of determining the epidemiology and antibiotic resistance pattern of uropathogens in each area.

Conclusion

Considering the different antibiotic resistance pattern in different areas and the spread of resistance to common antibiotics administered in empirical therapy, it is recommended a periodic review of antibiotic resistance pattern in each area. According to this study, *E. coli* was identified as the most common urinary pathogen. The highest antibiotic resistance, in both genders regardless of the type of bacteria, were cefixime, ceftriaxone and cotrimoxazole that they are not recommended as the first line of antibiotic therapy. On the other hand, the highest antibiotic susceptibility was observed with imipenem, nitrofurantoin and ceftazidime and it is better to use these antibiotics in the treatment of the urinary tract infections.

Limitations of the study

This study had a limited proportion of sample size and it needs further examinations by larger samples.

Authors' contribution

All authors passed four criteria for authorship contribution based on recommendations of the International Committee of Medical Journal Editors. MR and MB conducted the research. MM and AF wrote the primary draft. MB prepared the final paper. MR conducted the final check of the paper. All authors read and signed the final paper.

Conflicts of interest

The authors declare that they do not have any conflict of interest.

Ethical considerations

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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